Aerosol-Warm Microphysics Closure Observed from the Twin Otter

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- Review of observations from the Twin Otter
- Aerosol-CCN Closure
- Aerosol-Warm cloud microphysics closure

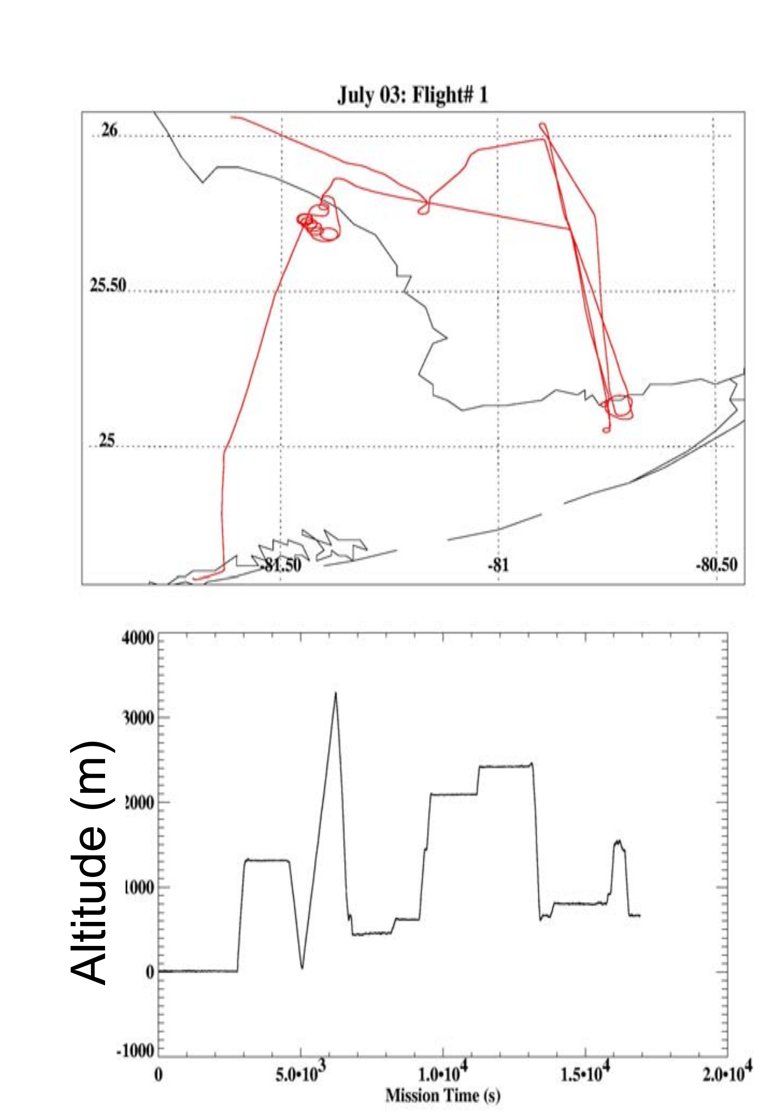
Goals and Role of the Twin Otter

- Characterize the aerosol feeding the convective systems studied by the high flying aircraft *(Poster: Varutbangkul)*
- Provide lower boundary condition on the radiative fluxes *(e.g. Pilewskie)*
- Understand the processes controlling warm cloud microphysics *(Present Talk; Poster: VanReken)*

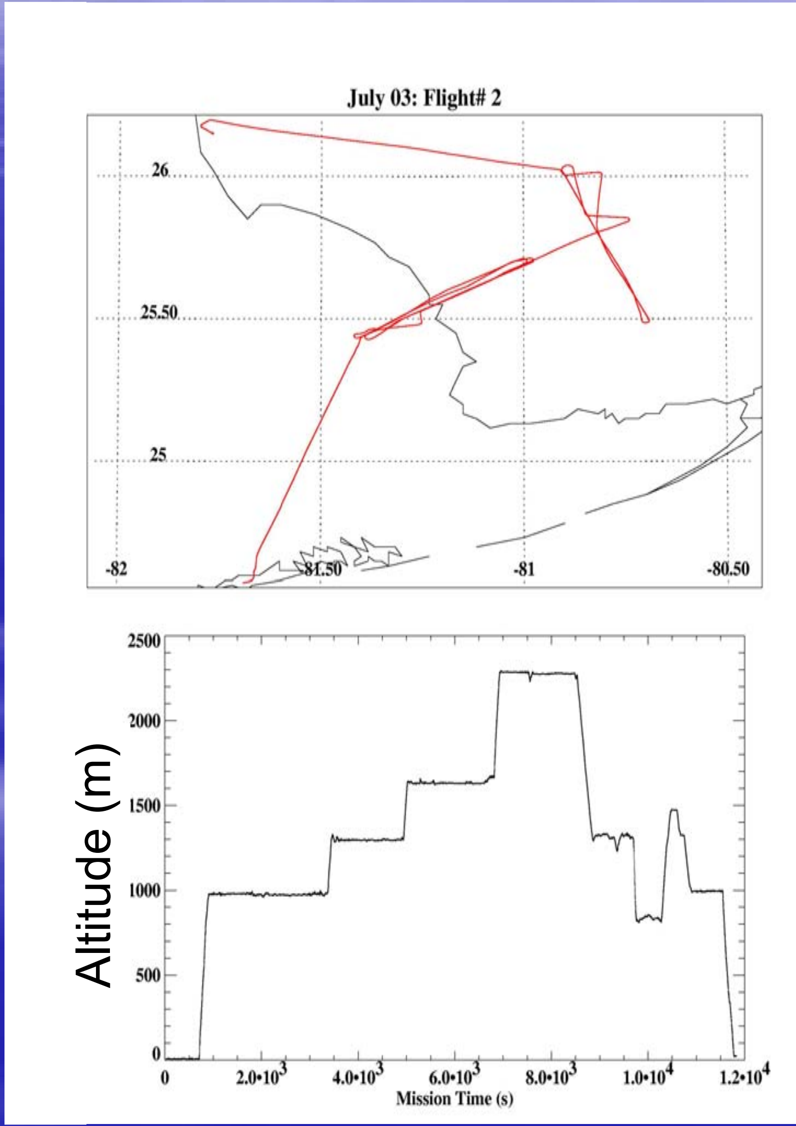
CIRPAS Twin Otter

Morning vs. Afternoon Flights

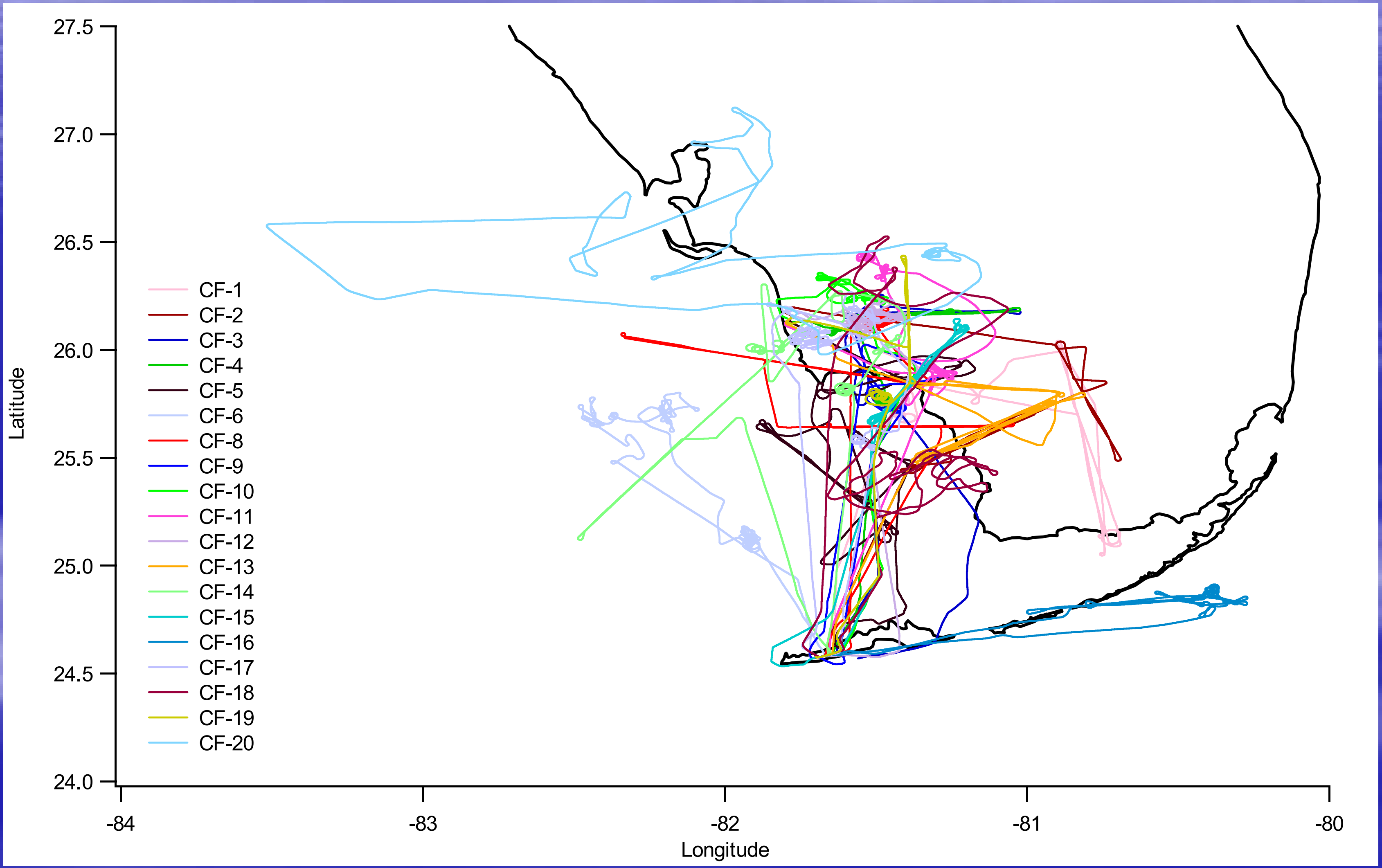
Typical Morning Flight



Typical Afternoon Flight



Flight Tracks for Twin Otter Flights

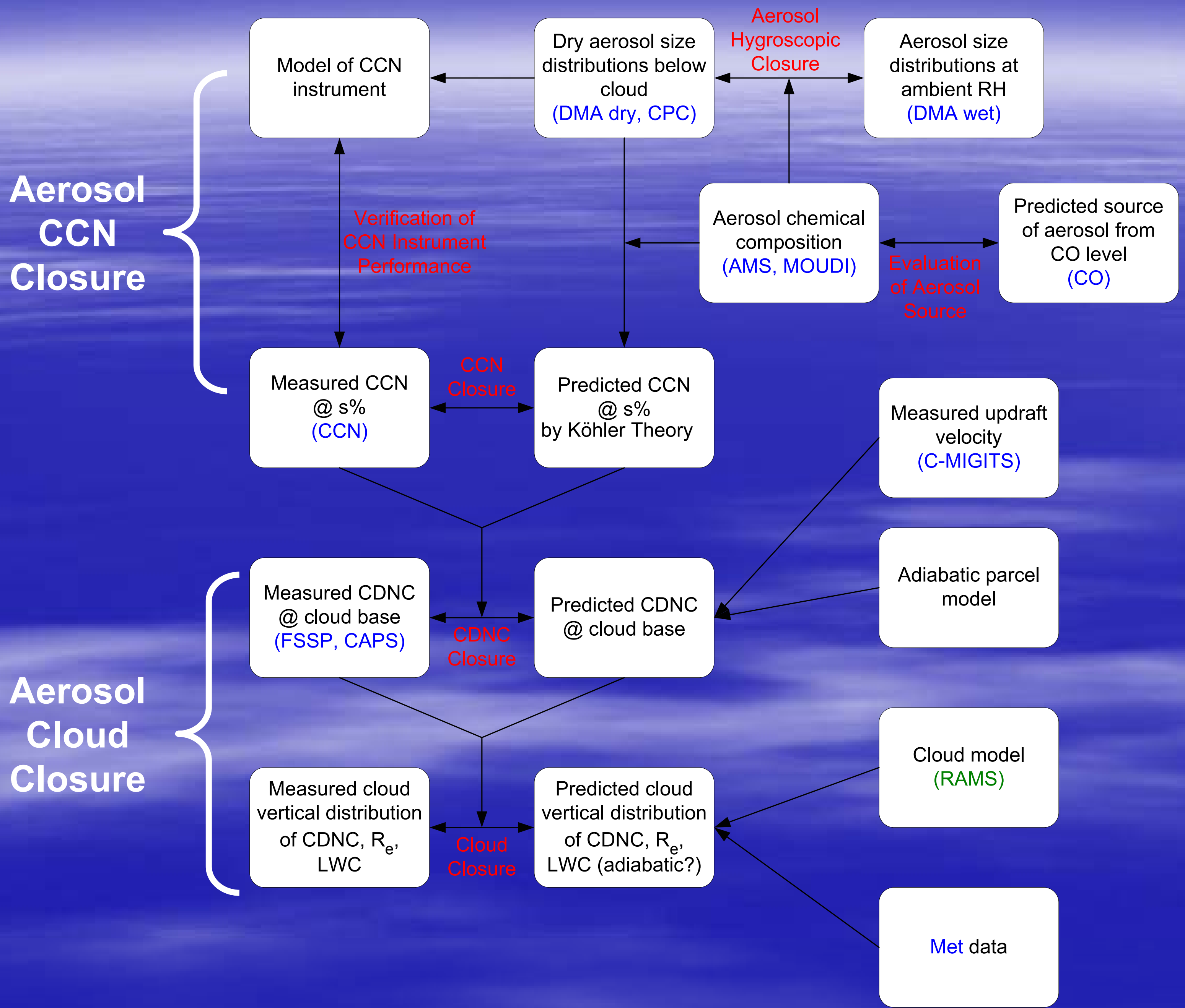


Consistency Among Aerosol, CCN, and Cloud Microphysical Properties:

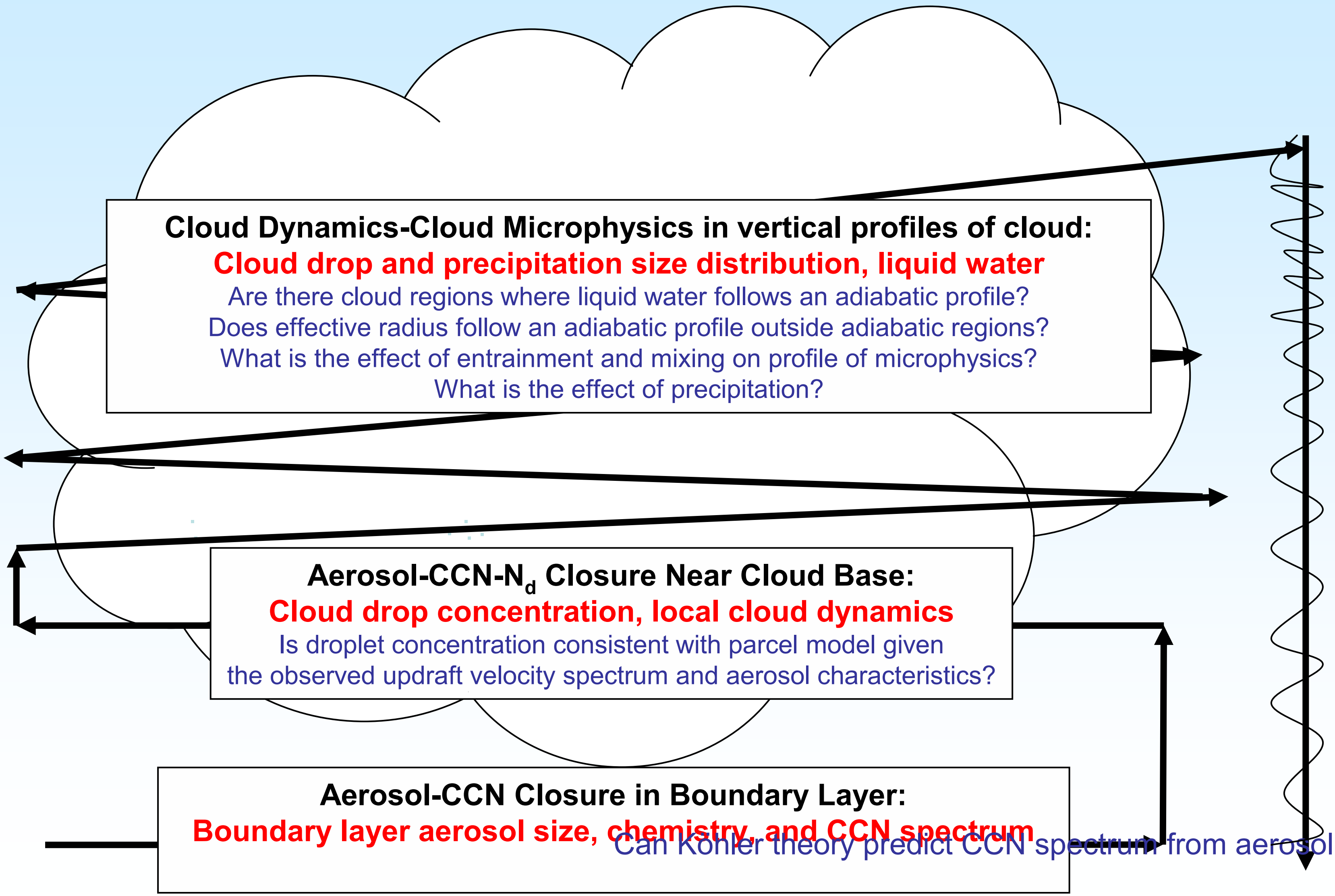
Aerosol Thermodynamics Models

- Explicitly models aerosol thermodynamic properties including kinetic and chemical effects
- Models developed by A. Nenes
- Input: Aerosol size distribution from DMA/PCASP measurements (10 nm – 2500 nm); Aerosol chemical composition
- These cases assume Ammonium bisulfate based on preliminary AMS composition data and general agreement in CCN closure
- Three applications : Aerosol hygroscopy; Modeling of CCN instrument; Adiabatic Cloud Parcel

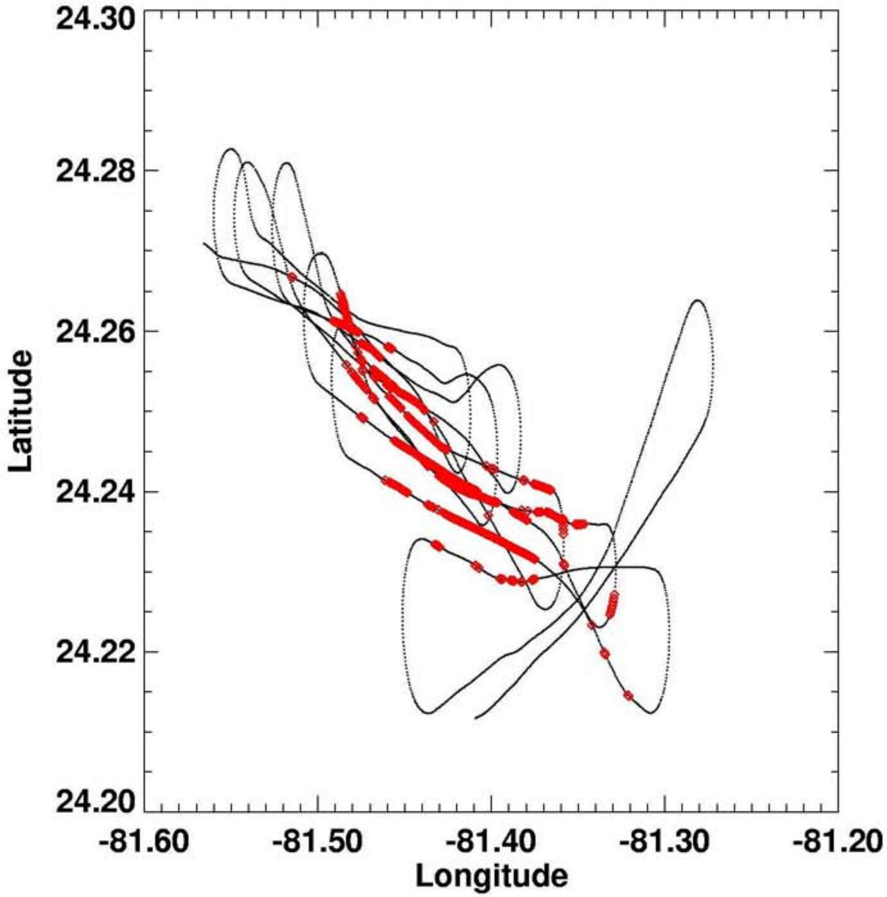
CRYSTAL-FACE Twin Otter Cloud Research Strategy

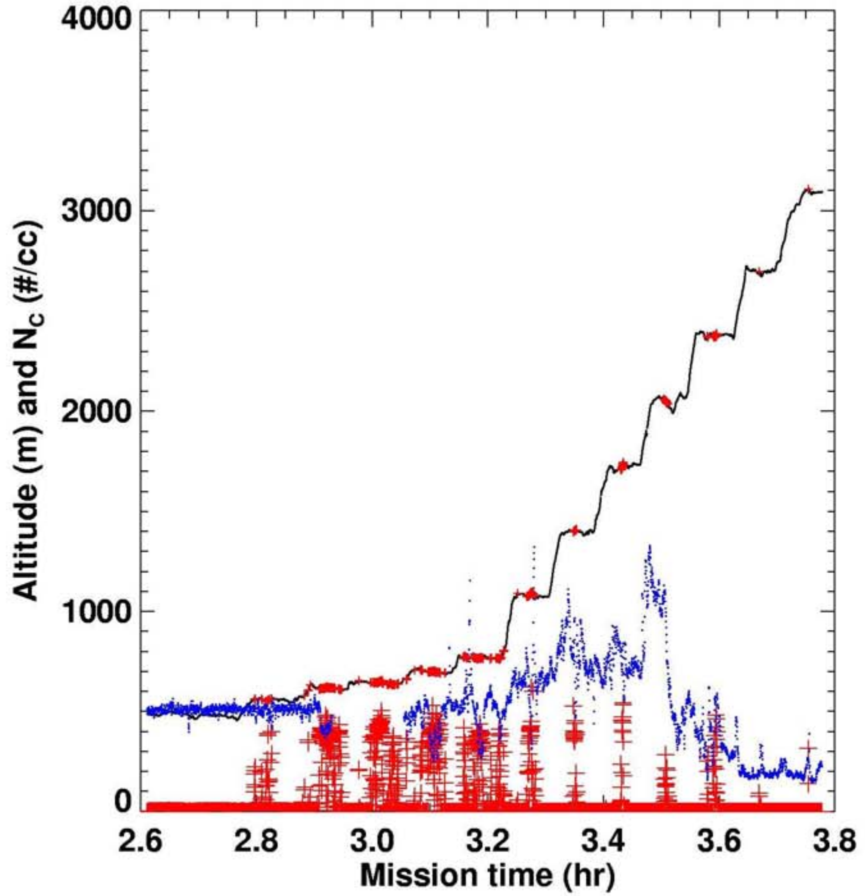


Warm Cloud Aerosol Sampling Strategy

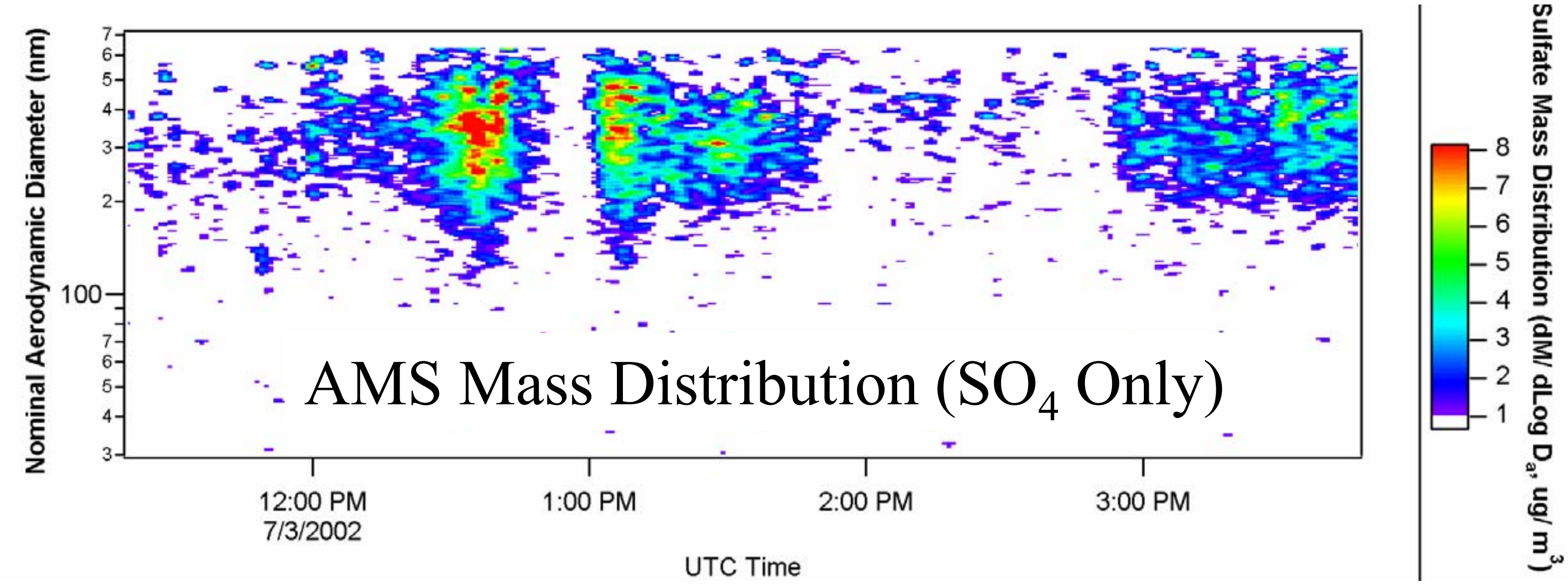


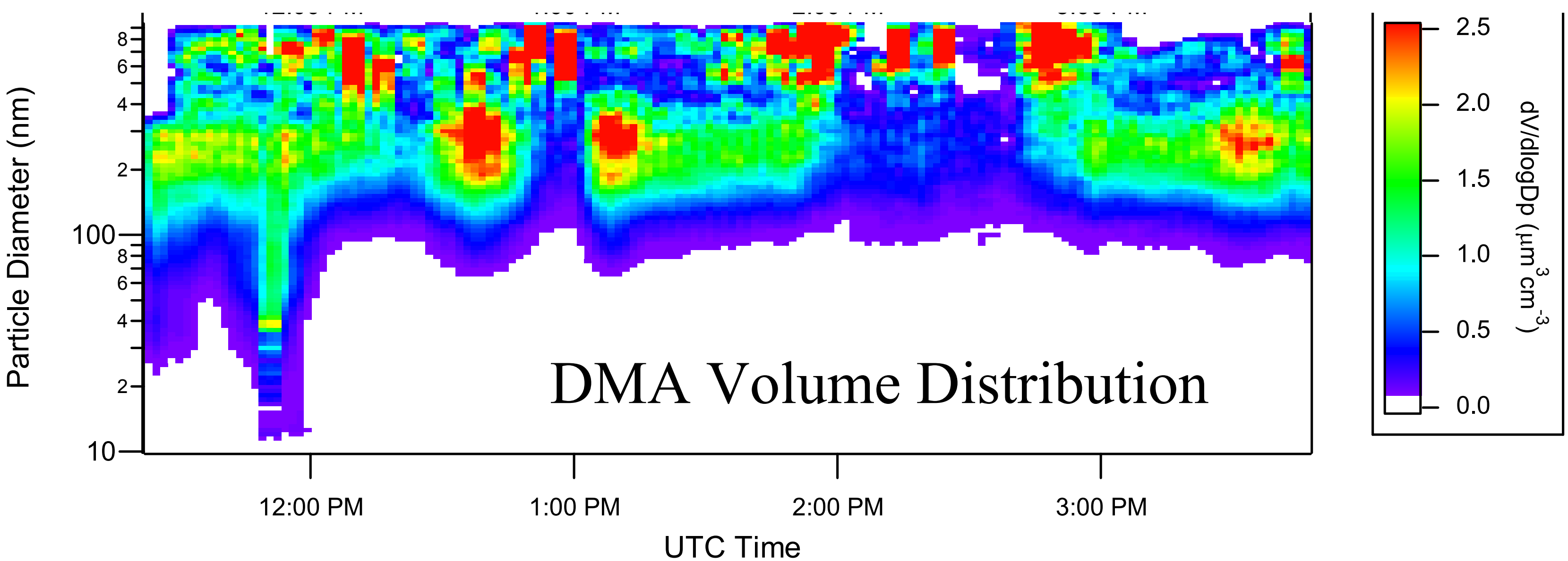
Cloud Profiling Strategy





Aerosol Size and Composition Measurements



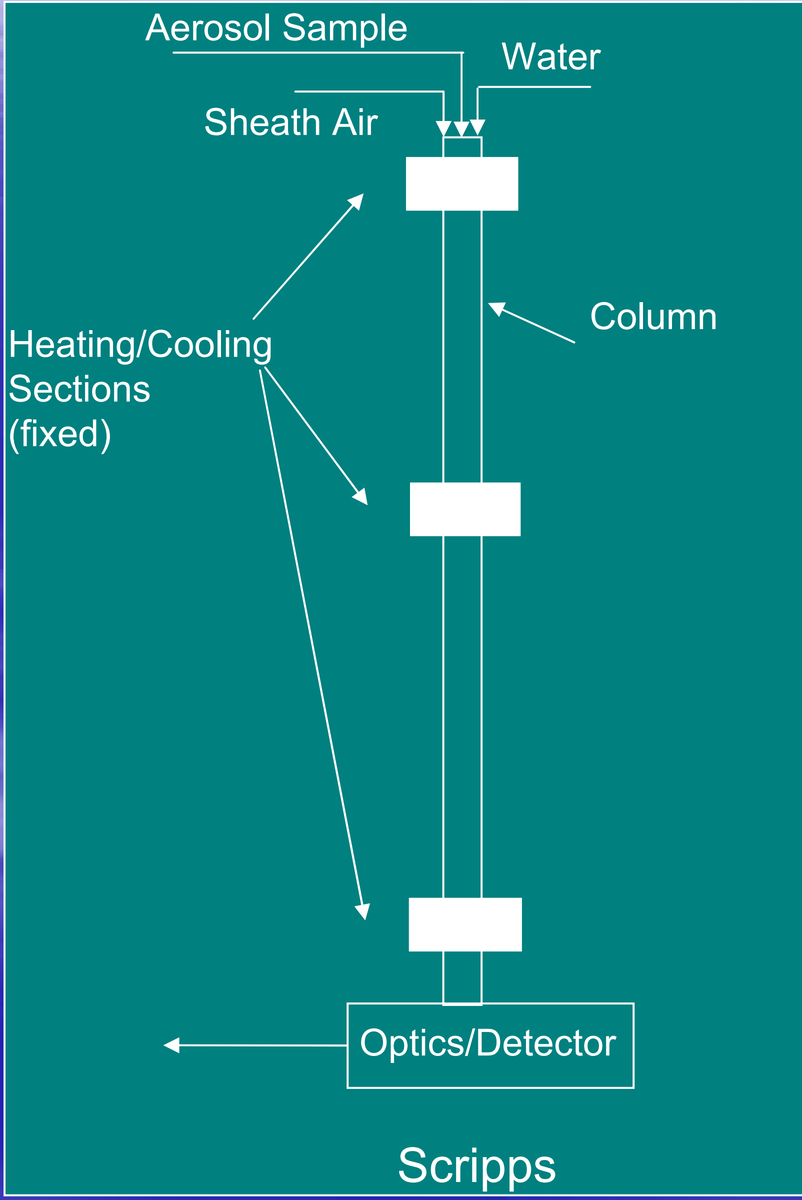


Source: Varutbangkul et al. (Poster)

CCN Instrument Configurations

- Roberts and co-authors determined that a stable supersaturation profile could be obtained by continuously *increasing* the temperature axially along the column wall.

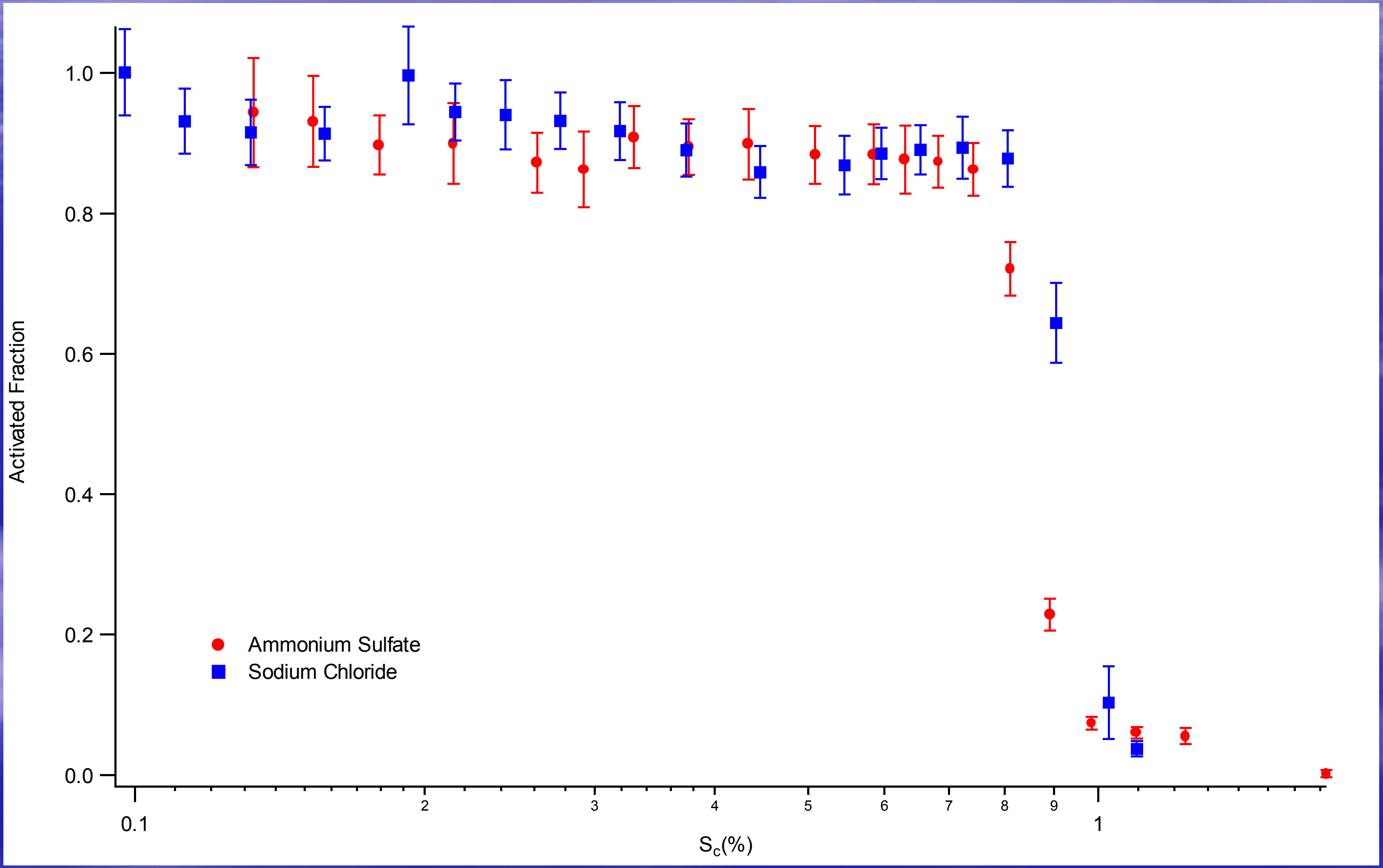
- The water vapor diffuses more rapidly than heat; inducing a stable supersaturation at the centerline.



Source: VanReken et al. (Poster)

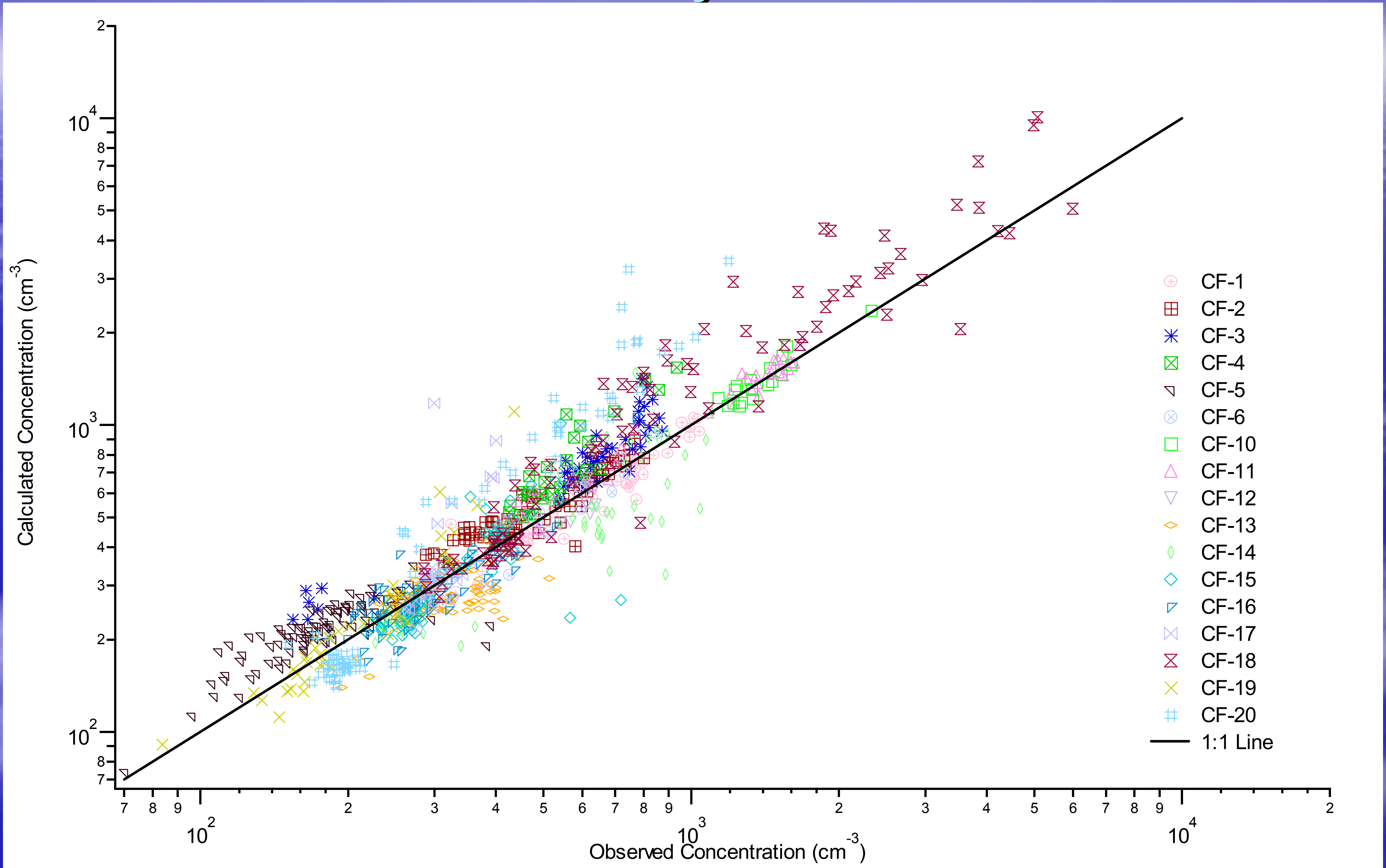
Laboratory Verification: Results

Activated Fraction vs. Critical Supersaturation



Source: VanReken et al. (Poster)

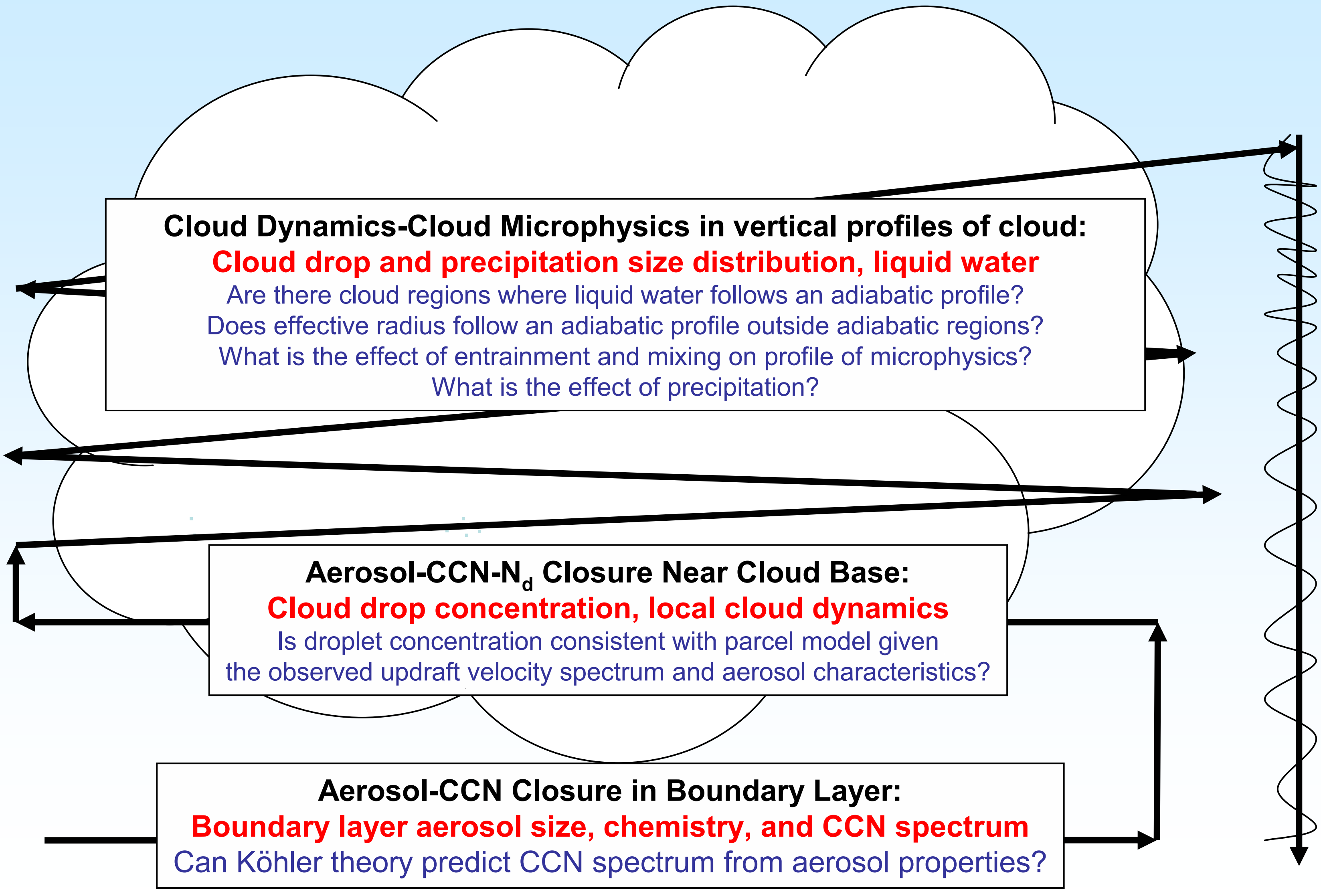
Closure Analysis: S=0.8%



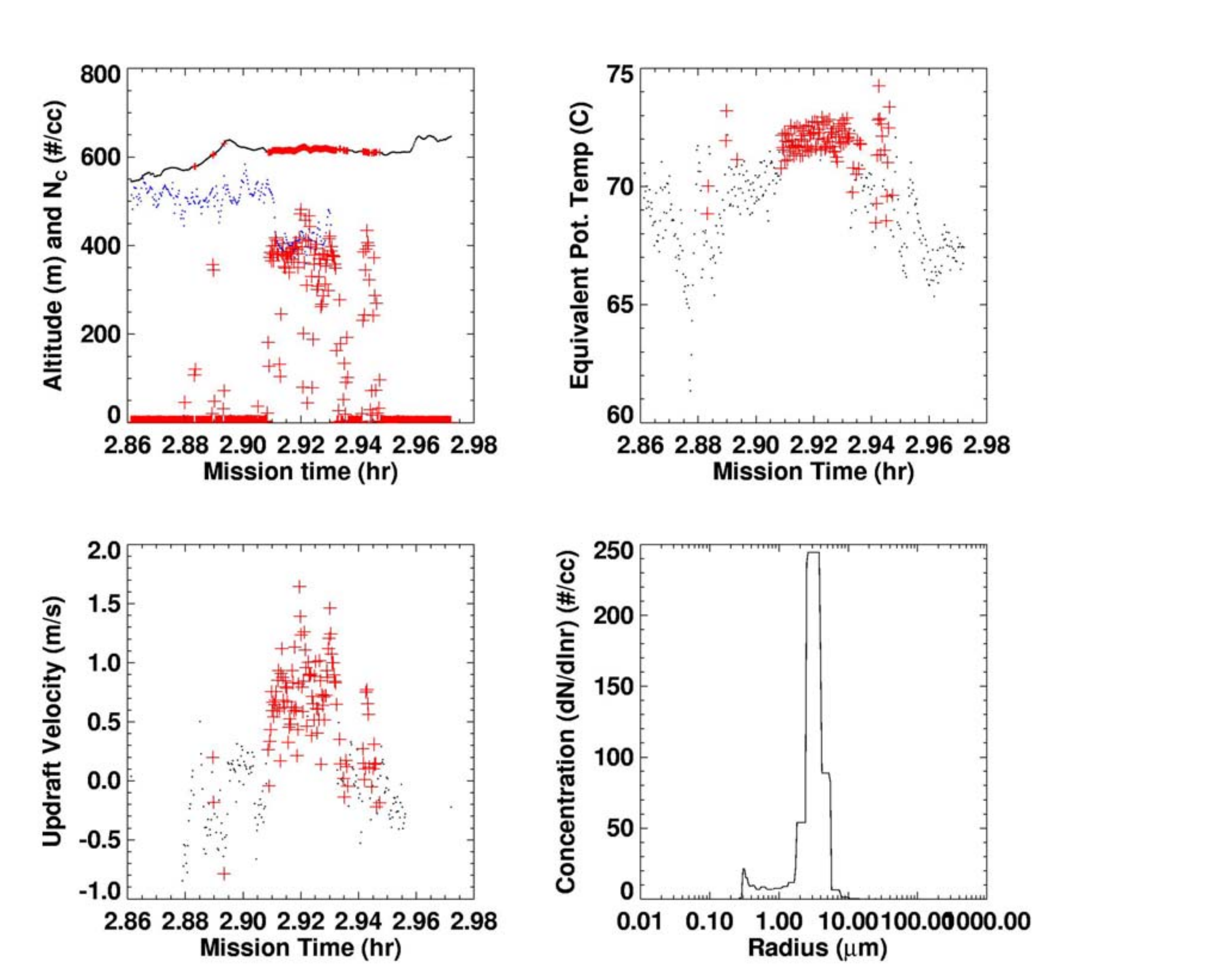
Line Fit: Slope=1.23 R^2=0.82

Source: VanReken et al. (Poster)

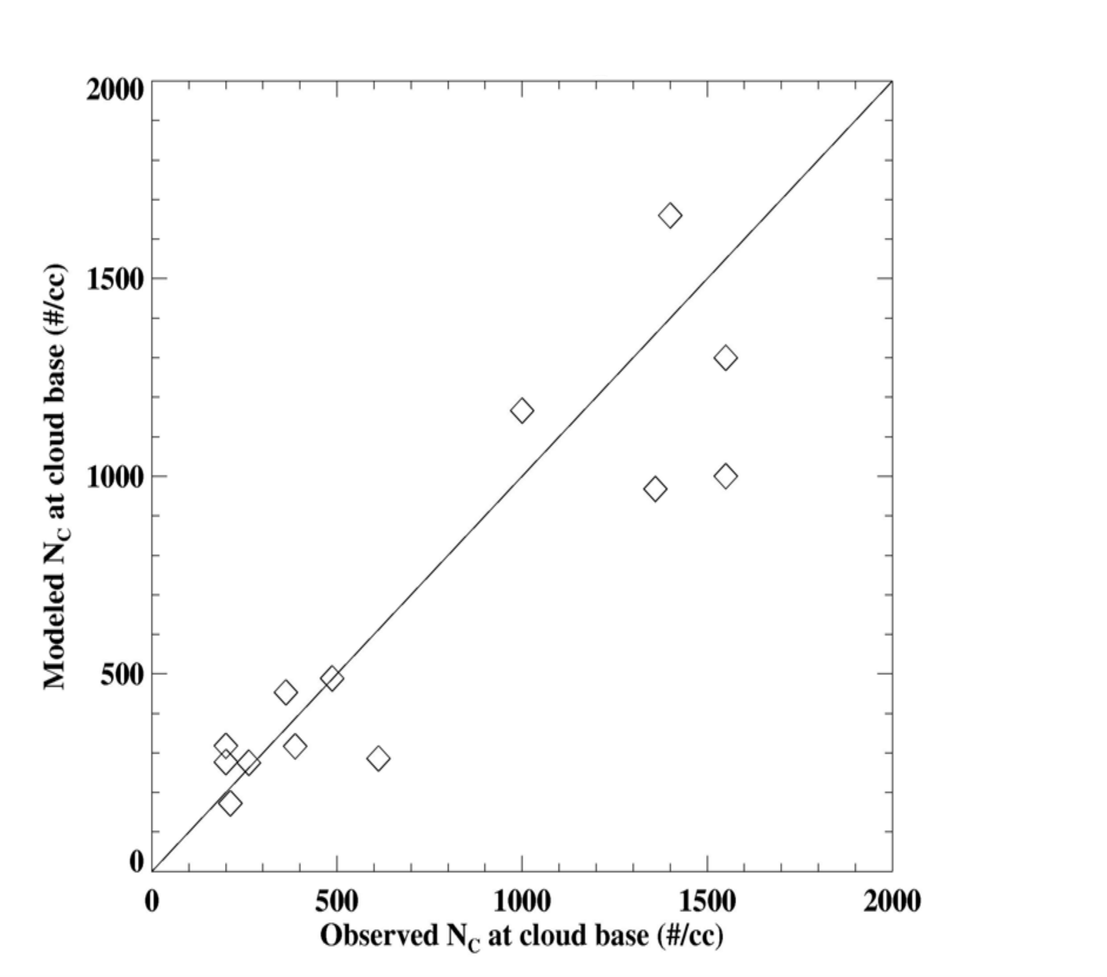
Warm Cloud Aerosol Sampling Strategy



Cloud Base Pass

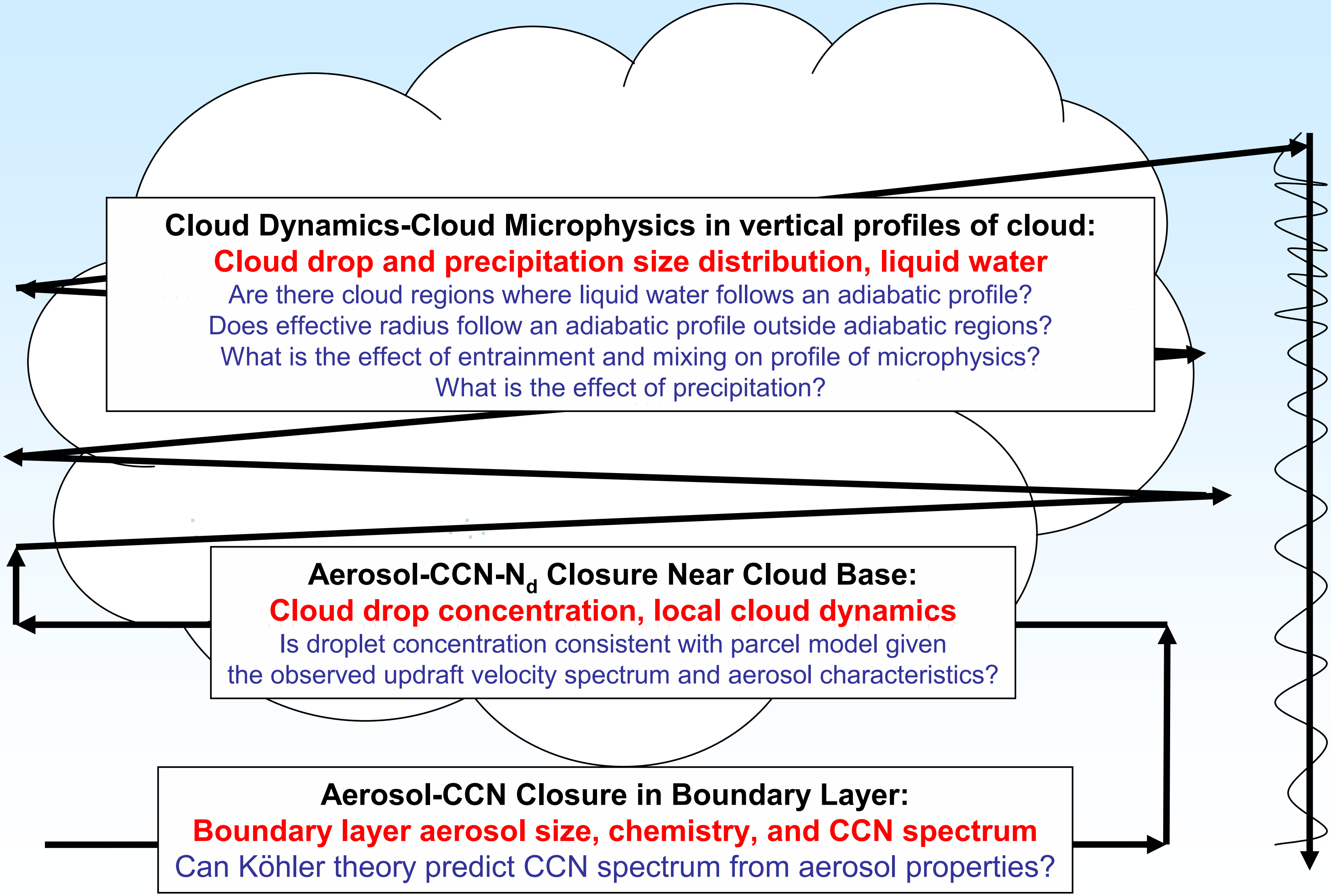


Aerosol-Cloud Drop Closure

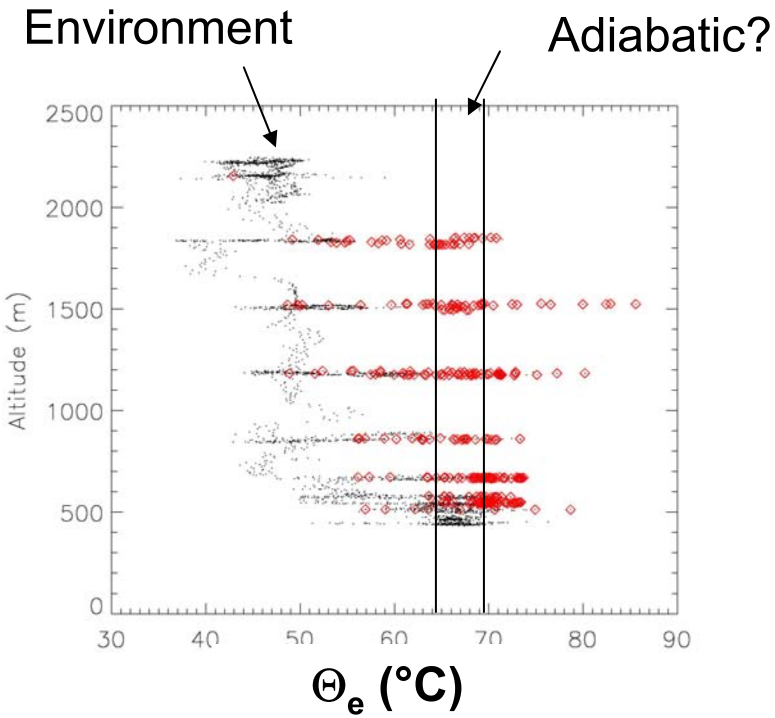


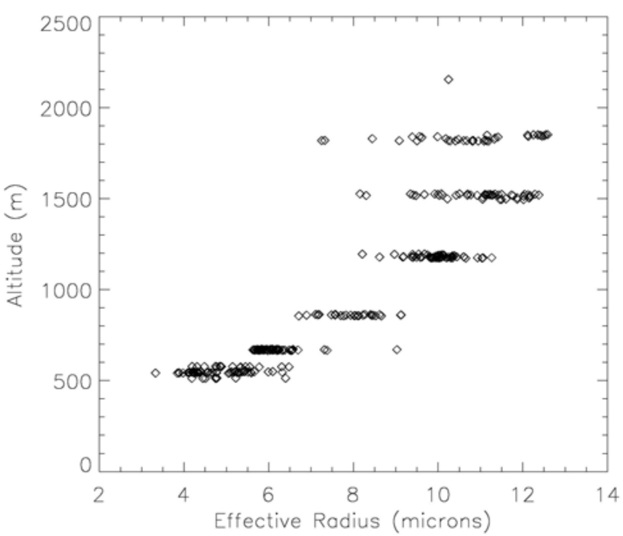
Agreement found for the 13 vertically profiled cumulus

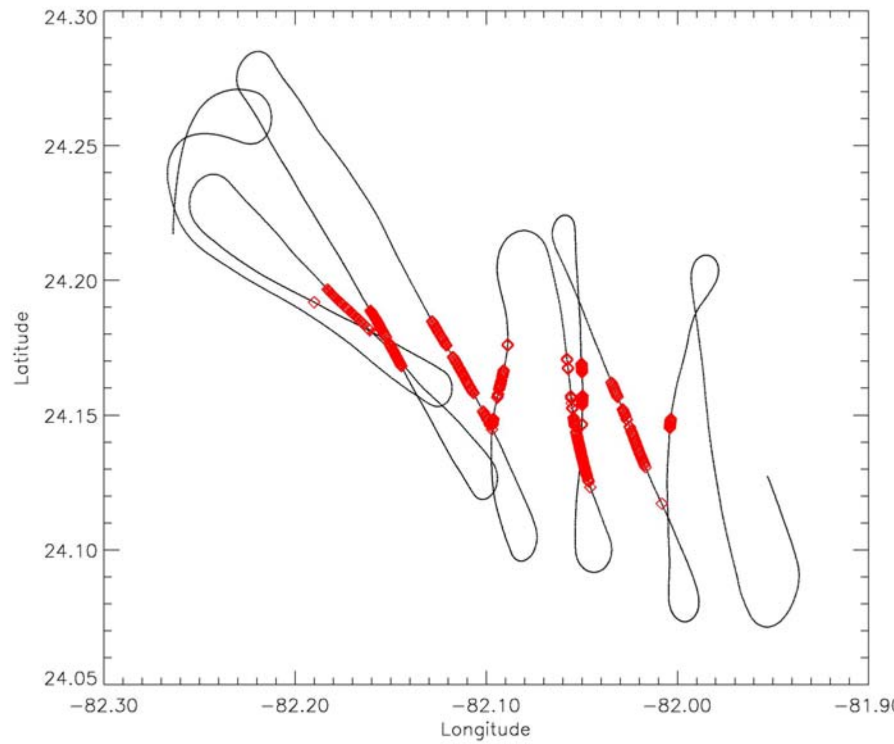
Warm Cloud Aerosol Sampling Strategy



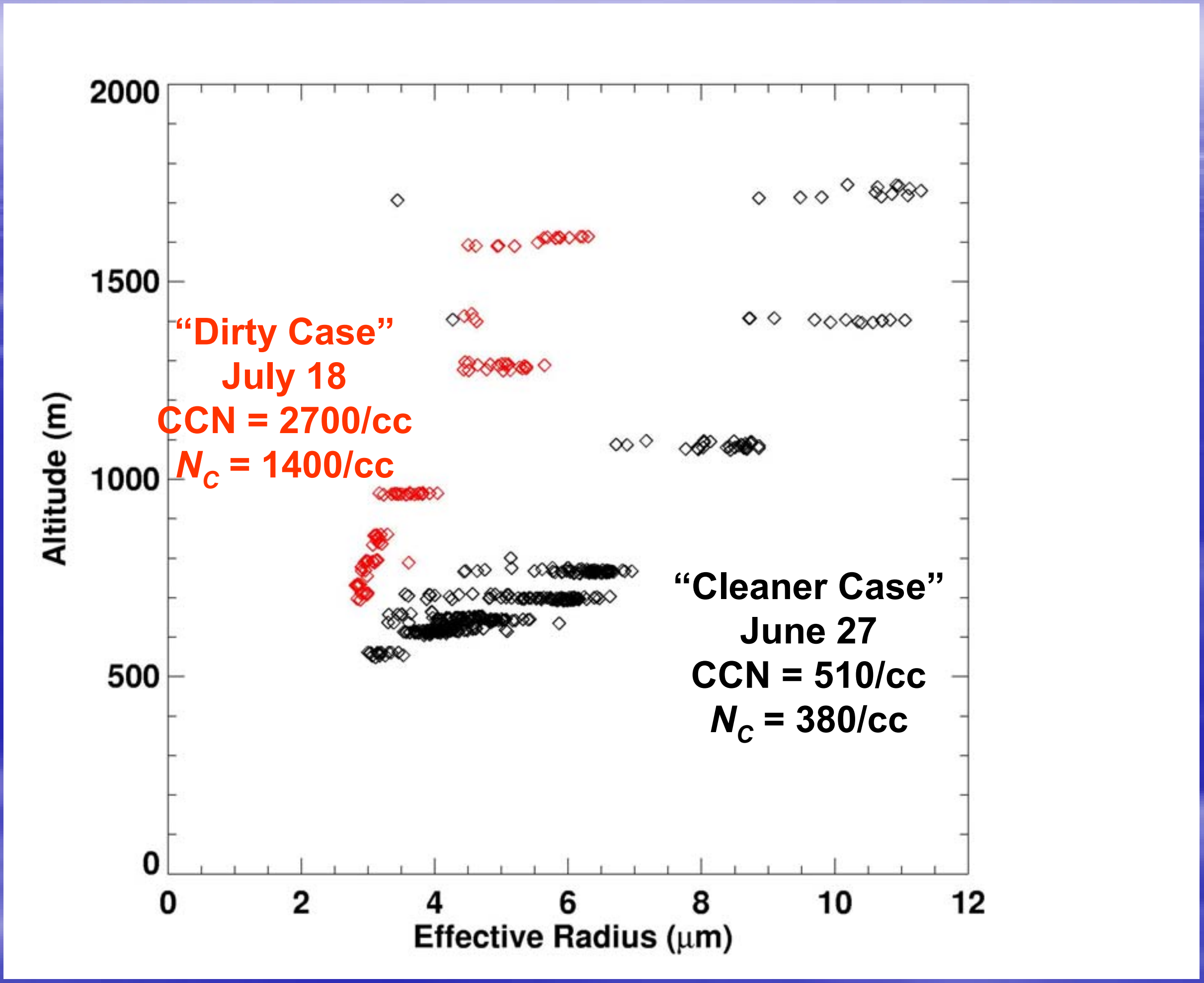
Cloud Profiling







Land-Ocean Contrast



Aerosol is the primary driver of droplet concentration and effective radius throughout the column.

What Next?

- How does the warm cloud indirect effect affect ice nucleation (and anvil radiative properties)?
- Are variations in chemistry (measured by AMS) influencing warm cloud activation?
- Can we elucidate the processes governing cloud drop dispersion?
- Can we discern the roles of concentration, dispersion and giant nuclei on precipitation formation?

More Twin Otter Science at T/Th Poster Sessions

- VanReken et al. – *Aerosol/CCN closure using in situ measurements from the Twin Otter*
- Varutbangkul et al. – *Aerosol Size and Composition from the Twin Otter during CRYSTAL-FACE*
- Campos et al. – *Lower tropospheric measurements of water vapor and CO*